3D Measurements of alpine skiing with an inertial sensor motion capture suit and GNSS RTK system

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Abstract: To date, camcorders have been the device of choice for 3D kinematic measurement in human locomotion, in spite of their limitations. This study examines a novel system involving a GNSS RTK that returns a reference trajectory through the use of a suit, imbedded with inertial sensors, to reveal subject segment motion. The aims were: (1) to validate the system's precision and (2) to measure an entire alpine ski race and retrieve the results shortly after measuring. For that purpose, four separate experiments were performed: (1) forced pendulum, (2) walking, (3) gate positions, and (4) skiing experiments. Segment movement validity was found to be dependent on the frequency of motion, with high accuracy (0.8°, s = 0.6°) for 10 s, which equals ~10 slalom turns, while accuracy decreased slightly (2.1°, 3.3°, and 4.2° for 0.5, 1, and 2 Hz oscillations, respectively) during 35 s of data collection. The motion capture suit's orientation inaccuracy was mostly due to geomagnetic secular variation. The system exhibited high validity regarding the reference trajectory (0.008 m, s = 0.0044) throughout an entire ski race. The system is capable of measuring an entire ski course with less manpower and therefore lower cost compared with camcorder-based techniques.

Author Keywords: Global navigation satellite system; GPS; Human locomotion; Moven MoCap suit; Real-time kinematics

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